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AN INTERACTIVE DISPLAY FOR THE 21st CENTURY:

Beyond the Desktop Metaphor

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Vannevar Bush's 1945 vision of a personal desk-sized machine (the *memex*) containing a massive library of information and powerful search and recall mechanisms remains an inspired view of a useful personal computer. By 1970 Alan Kay at Xerox Palo Alto (California) Research Center was proposing a dynamic book-sized computer, a *dynabook*, that would satisfy most of the needs of users of all ages. By 1973 a group of his colleagues had built a small desk-sized computer, the Alto, that was starting to satisfy Kay's vision. By the mid-1980's the Apple Macintosh, and similar machines, were having the same effect on users worldwide. Common to all these visions was the computer interaction mechanism consisting of a 2D computer display that appeared like stylized version of the user's desktop: papers strewn about, ones on top obscuring ones below; various objects of interest, such as trash cans and clocks, serving their obvious and useful functions. The user moved objects about the screen and took them in and out of file folders by direct manipulation. In certain situations, the user could "zoom in" to certain papers for a closer look.

This is a fine model for 2D applications and is properly on its way toward universal adoption. Applying it to 3D applications is more troublesome: it is difficult to visualize 3D objects and scenes on a 2D screen and even more difficult to manipulate them. To understand the additional burden of 3D over 2D, consider the comprehension of a 3D design of a small house versus the comprehension of a 2D example of schematic layout -- current graphic workstation well adapted to the schematic layout, not well adapted for understanding the 3D spacial structure of the house. Just moving through the house, constantly changing viewing position and looking about would be very awkward. Modifying even a simple portion of the design, such as moving the location of a door, would indeed be difficult.

Sutherland's 1965 vision of the "ultimate display" and his 1968 demonstration of head-mounted display as the first approximation remain the most promising user devises for truly interactive 3D display of the 21st century. Unfortunately Sutherland's 1968 display was so far ahead of its time that little of the enabling technology was then (or even now is) available. A few researchers [Fisher 86] have been developing this vision, but most experts have relegated the head-mounted display to a mere paragraph in each textbook. The military applications have been attractive enough, however, that there is sufficient long-standing interest to support a two-day conference ("Helmet-Mounted Displays", SPIE conference Number 1116, March 28-29, 1989, Orlando, Florida).

Several difficult problems need to be solved before a widely useful system can enlarge the user's computer space from the virtual desk to the virtual office. The image generation needs to be at least 30 frames per second and very likely 60 frames per second. The head gear needs to be reduced from its current helmet size to one that's closer to the size of a pair of clip-on sunglasses. The head-tracking should allow the user to roam within an office-sized environment without constraints.

Fortunately several new technologies based on microelectronics developments might provide solutions to the above problems. The solutions may be as far away as today's "walkman" is from crystal radios, so predictions of success are premature at best. Many would recommend that we abandon these systems for several decades to allow technology to develop. One can only hope that there are some developers who are not content to wait so passively.

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